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(54) Title of the invention	Method to produce non-woven polyester fiber sheet	(72) Inventor	2750-1 Minamiyoshida-cho, Matsuyama Tamio Yamamoto
			222-7 Kitaidomachi, Matsuyama Masumi Okumura
(21) Japanese Patent Application	S56-24950	(72) Inventor	41 Koazachudaisho, Oazaterada, Joyo
(22) Date of Application	February 24, 1981	(71) Applicant	Teijin Limited 1-11 Minamihonmachi, Higashi-ku, Osaka
(72) Inventor	Tadashi Hirakawa 1088-22 Kinokawa-cho, Kusatsu	(74) Representative	Attorney Sumihito Maeda
(72) Inventor	Makoto Yoshida 3-9-221 Minohara, Ibaraki		
(72) Inventor	Tsukasa Kobayashi		

SPECIFICATION

1. TITLE OF THE INVENTION

Process to produce non-woven polyester fiber sheet

2. SCOPE OF PATENT CLAIMS

1. A process of producing a non-woven polyester fiber sheet, wherein a wet paper sheet obtained by wet-laying a mixture of 10–90% by weight of drawn polyester staple fibers each having a denier of 3 or less and 90–10% by weight of undrawn polyester staple fibers each having a denier of 5 or less is dried or semi-dried, and then 5–50% of total area of the sheet is thermally pressed using an embossing calendar having a surface temperature of 120–280 °C.
2. A process of producing a non-woven polyester fiber sheet described in Claim 1, wherein individual drawn polyester staple fibers and undrawn polyester staple fibers have a length of 1–15 mm.
3. A process of producing a non-woven polyester fiber sheet described in Claim 1 or 2, wherein at least a part of drawn polyester staple fibers have 8–20 crimps per 2.54 cm of the fiber.
4. A process of producing a non-woven polyester fiber sheet described in Claim 1 or 2, wherein at least a part of drawn polyester staple fibers have latent crimps.
5. A process of producing a non-woven polyester fiber sheet described in one of the Claims 1–4, wherein at least a part of drawn polyester staple fibers and/or undrawn polyester staple fibers have non-circular cross section fibers.
6. A process of producing a non-woven polyester fiber sheet described in one of the Claims 1–5, wherein at least a part of drawn polyester staple fibers and/or undrawn polyester staple fibers have empty-core fibers.

3. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a non-woven fiber sheet having flexible and excellent texture and appearance and is used for products, such as hygiene products.

In recent years, dry-laid or wet-laid non-woven fiber sheet comprising hydrophobic polyester fibers has been used as the top sheet for hygiene products, such as diapers and sanitary pads, in particular. Dry-laid non-

woven fiber sheets, however, are flexible, but hard to attain with high levels of uniformity, and wet-laid non-woven fiber sheets, on the other hand, are generally uniform, but lack flexibility and are hard to the touch.

The purpose of the present invention is to obtain a non-woven fiber sheet having a nice soft texture as well as high levels of permeability and uniformity. The other purpose of the present invention is to obtain a flexible wet-laid fiber sheet, particularly suitable for use in hygiene products, comprising 100% polyester without any issues in toxicity of surfactants in the binder or binder emulsion.

In the present invention, the non-woven fiber sheet is produced by drying or semi-drying a wet paper sheet obtained by wet-laying a mixture of 10–90% by weight of drawn polyester staple fibers each having a denier of 3 or less and 10–90% by weight of undrawn polyester staple fibers each having a denier of 5 or less, and then thermally pressing 5–50% of total area of the sheet using an embossing calendar having a surface temperature of 120–280 °C.

Here, "polyester" is polymers obtained either by step-reaction polymerization or condensation polymerization of acidic ingredients, such as terephthalate, isophthalate, oxybenzoate, and sebacate, and glycolic ingredients, such as ethylene glycol, propylene glycol and neopentyl glycol. The drawn polyester staple fibers normally have a birefringence of about 0.165 or 0.175; however, for the other wet-lay ingredient, undrawn polyester staple fibers, the birefringence is preferably 0.1 or less, more preferably, 0.05 or less. The latter wet-lay ingredient serves as a binder, and is also effective in softening the texture. The US Patent No. 2,836,576 and Japanese Patent Application Publication No. S49-8809 have already disclosed a method to obtain a thin paper-like fiber sheet in which undrawn polyester staple fibers are blended in drawn polyester staple fibers, and the mixture is thermally pressed. The technology disclosed in the patents above, however, thermally presses the entire surface of the fiber sheet, and therefore it could only produce extremely paper-like non-woven fiber sheet lacking flexibility and bulkiness. The inventors of the present invention, on the contrary, succeeded in manufacturing extremely flexible and soft-to-the-touch non-woven fiber sheets by selecting and combining a proper range of thermal pressing area, denier of fibers used, and mixing ratio.

In the present invention, the drawn polyester staple fibers have a denier of 3 or less, preferably 0.1–1.5 deniers, or more preferably, 0.2–0.9 deniers. In certain cases, the drawn staple fibers may be a mixture of staple fibers of different deniers comprising mainly of fibers having a denier of 3 or less. Caution must be taken as the denier of drawn staple fibers becomes excessively low the permeability of the non-woven fiber sheet tends to fail. On the other hand, if the denier becomes excessively high, proper wet-laying, i.e., dispersion of fibers in water, as well as release of wet paper sheet from the wires may fail and further resulting in poor strength of the product after the embossing process.

As for the denier of undrawn polyester staple fibers, it needs to be 5 or less. If the denier of undrawn polyester staple fibers is too high, the resultant non-woven fiber sheet will be hard-to-the-touch and the strength will also decline. The preferred range of denier, in particular, is 0.5–1.3.

The preferred length of fiber of drawn polyester staple fibers and undrawn polyester staple fibers is 1–15 mm. If the fibers are too short, the strength of non-woven fiber sheet will decrease. On the contrary, if the fibers are too long, they will not disperse well in water, and the resultant fiber sheet may highly likely have an uneven quality.

In the present invention, when crimp fibers having 8–20 crimps per 2.54 cm of fiber is used in at least a part of drawn polyester staple fibers, the non-woven fiber sheet results in excellent flexibility and bulkiness. Latent crimp fibers may be used in at least a part of drawn polyester staple fibers for the same purpose. When the latent crimp fibers are used, the fibers are dispersed in water during wet-laying before the crimps emerge, and the crimps emerge after the fiber sheet is wet-laid. For this reason, the resultant non-woven fiber sheet has a good dispersing property in water, and a nice and even web.

Furthermore, the flexibility and bulkiness of the fiber sheet may be improved by using non-circular cross section fibers, such as fibers with triangle, flat, star-shaped, or semicircle cross section, or empty-core fibers

in at least a part of drawn polyester staple fibers and/or undrawn polyester staple fibers.

The paper in the present invention is laid by a normal wet-laying method, that is to say, by using one of the papermaking machines, such as cylinder paper machine, Fourdrinier paper machine, Yankee paper machine, or sloped paper machine, and the wet paper sheet obtained is dried or semi-dried. When undrawn staple fibers have a relatively low birefringence (for instance, 0.01 or less) or the moisture content of undrawn staple fibers is relatively high (for instance, 40% or more), dried stock possesses necessary process strength for rolling, and therefore, there is no particular problem. When the birefringence of undrawn staple fibers, however, is relatively high (for instance, 0.02 or more), or the moisture content of undrawn staple fibers is relatively low (for instance, 30% or less), the dried stock does not have sufficient process strength for rolling, and thus the stock is semi-dried/semi-wet to give it strength and then rolled.

The laid stock is thermally pressed by an embossing calendar having a surface temperature of 120–280 °C, preferably 150–260 °C. If the surface temperature of embossing calendar is excessively low, the stock will not have a sufficient strength, and if the surface temperature is excessively high, the stock melts on to the surface of emboss rollers, which should be avoided. The area to be thermally pressed needs to be 5–50%, preferably 10–30%, of the entire area of fiber sheet. If the thermally pressed area is too small, the resultant non-woven fiber sheet will not have enough strength, and if the area is too large, the fiber sheet becomes tough and looses nice texture, and ends up in a paper-like non-woven fiber sheet.

The non-woven fiber sheet made by the method of present invention has excellent flexibility and bulkiness in addition to its favorable texture. For this reason, the fiber sheet can be used as a top sheet for diapers and sanitary pads, other hygiene products, disposable clothing, thermal insulating materials, packaging materials, as well as reinforcement for polyvinyl chloride, polyurethane and so forth, which can be used as a core sheet for leather products. The fiber sheet is particularly suitable for hygiene products not only because of its flexibility, bulkiness, and excellent texture, but also it does not use potentially toxic binders (for example, surfactant for binder emulsion).

The following is a detailed description of the present invention using examples. In the examples, the strength was tested in accordance with Japanese Industrial Standard (JIS) P-8113 using a constant strain speed tensile tester, and the bending resistance was tested in accordance with JIS L-1074A (cantilever bending test).

Embodiments

1.0 wt% stock mixture comprising 50% drawn polyethylene terephthalate staple fibers having a denier of 0.5 and a fiber length of 5 mm and 50% undrawn polyethylene terephthalate staple fibers having a denier of 1.1 and a fiber length of 5 mm was melted in a regular heater. The slurry was then laid into a wet paper sheet in a regular cylinder paper machine, and the wet paper sheet was dried in a Yankee drier having a surface temperature of 120 °C: a sheet having a weight of 20g/m^2 was obtained. The sheet was then embossed in a heating calendar (surface temperature 200 °C) having a pattern as shown in the drawing. 16% of the total area of the sheet was thermally pressed.

The non-woven fiber sheet obtained was extremely flexible, bulky, and had a nice texture having a tensile strength of 0.63 Kp (vertically) and 0.48 Kp (horizontally), and a bending resistance of 26 mm (vertically) and 23 mm (horizontally).

On the other hand, the contrast non-woven fiber sheet prepared by thermally pressing the entire surface of the dried sheet in calendar rolls was extremely rough and tough, and had a paper-like texture having a tensile strength of 2.3 Kp (vertically) and 1.7 Kp (horizontally), and a bending resistance of 56 mm (vertically) and 54 mm (horizontally).

4. BRIEF DESCRIPTION OF THE DRAWINGS

The drawing is an example of embossing patterns on the embossing calendar heating rolls used in the present invention.

Applicant: Teijin Limited
Representative: Attorney, Sumihiro Maeda
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